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# Marine Physical Laboratory

## Geomorphological and Geomorphometry of the East Pacific Rise Flanks

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# Geomorphological and Geomorphometry of East Pacific Rise Flanks

Peter F. Lonsdale

Final Report to the  
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## *Abstract*

A marine geophysical survey of the seafloor east and west of the rise crest ONR Natural Laboratory was used to interpret the geologic history that has determined the shape, structure, and pattern of the present East Pacific Rise axis, and to study the fates of crust after it leaves the axis. The emphasis of this work was on tectonic processes that modify the structure of young oceanic crust, and on quantifying the effects of these processes on seafloor roughness.

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## *Research Objective*

The objectives of this project were (1) to establish the geologic history of a large tract of seafloor containing on ONR Natural Laboratory, and thereby derive better understanding of the typical long-term behavior of a fast-spreading rise crest; and (2) to improve quantitative assessments of seafloor roughness in areas of known and complex geologic history. The first objective has been met more completely than the second.

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### *Research Summary*

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The primary data used were Seabeam 2000 multibeam bathymetric swaths, magnetic and gravity profiles collected on a 1993 cruise leg to the eastern tropical Pacific. Similar supplementary data was collected in 1995 to fill in what proved to be critical gaps in the principal survey. Coverage of the large study area with new data was by no means complete, so its interpretation required analysis of the large archived volume of preexisting data.

The past 10 m.y. of geologic history proved to include major changes in the rate and direction of spreading, reorientation and abandonment of spreading centers and transform faults, migration of large propagating rifts, and formation and capture of microplates. Only for the past 4 m.y. has this part of the East Pacific Rise had a steady, simple pattern of crustal accretion and deformation. The 10-4Ma geologic history has much in common with the history of the Mathematician microplate region further north, and a comparison of these histories (now being prepared for publication) clarifies which features are merely local idiosyncrasies, which are prevalent patterns of crustal evolution.

Statistical analyses of the multibeam bathymetry have been performed by Dr. Ute Herzfeld (formerly of Scripps Institution of Oceanography) and Dr. Peter Shaw (formerly of Woods Hole Oceanographic Institution). These analyses were able to identify patches of different topographic roughness and lineation direction, patches that could be explained by the conventional geophysical interpretation. They did not, however, materially enhance that interpretation.

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### *Publications*

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- 1) P. Lonsdale (1995). Segmentation and disruption of the East Pacific Rise in the mouth of the Gulf of California. *Marine Geophysical Researches*, v.17, 323-359.
- 2) E. Baker and P. Lonsdale (1993). Rifting of oceanic lithosphere during growth of the South Mathematician microplate, "EOS, Trans. Am. Geophys. Union, Supplement, p. 605
- 3) K. Williams and P. Lonsdale (1993). Two types of fossil spreading center on Mathematician Ridge. EOS, Trans. Am. Geophys. Union Supplement, p. 605

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